

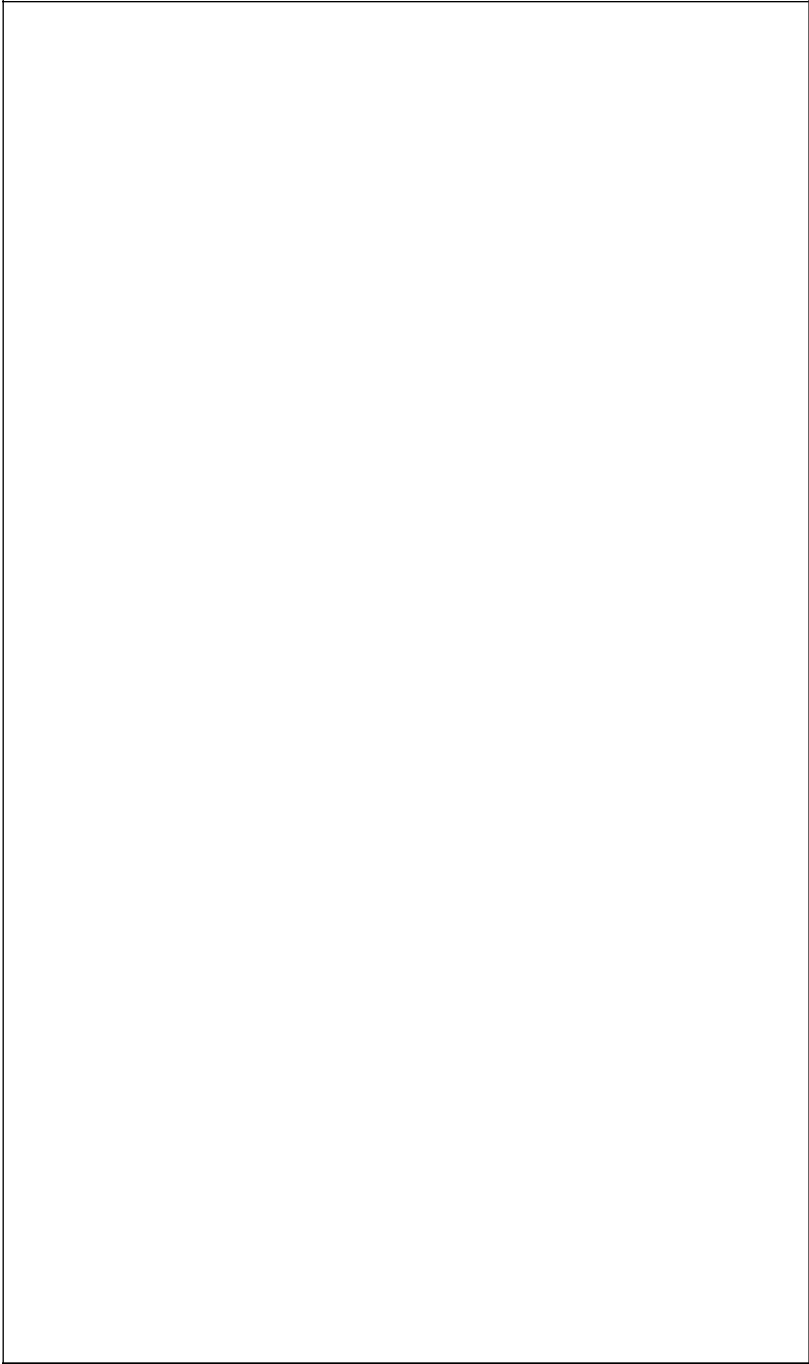
San Diego Area

Electrical Newsletters

Based on the
1993 edition of the
National Electrical Code

January 1996





About the San Diego Area Electrical Newsletters

San Diego Area Electrical Newsletters

are developed through a cooperative effort of the San Diego Area Inspection Jurisdictions and are approved by the San Diego Chapter of the International Conference of Building Officials.

The newsletters provide interpretations of the National Electrical Code and examples of installations that are generally acceptable in the San Diego Area. Check with the local inspection jurisdiction before beginning any installation based on these newsletters.

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Subscriptions to the newsletters are available from the City of San Diego. Subscriptions are for the period that the 1993 NEC is in effect and include any updates or changes published during that period.

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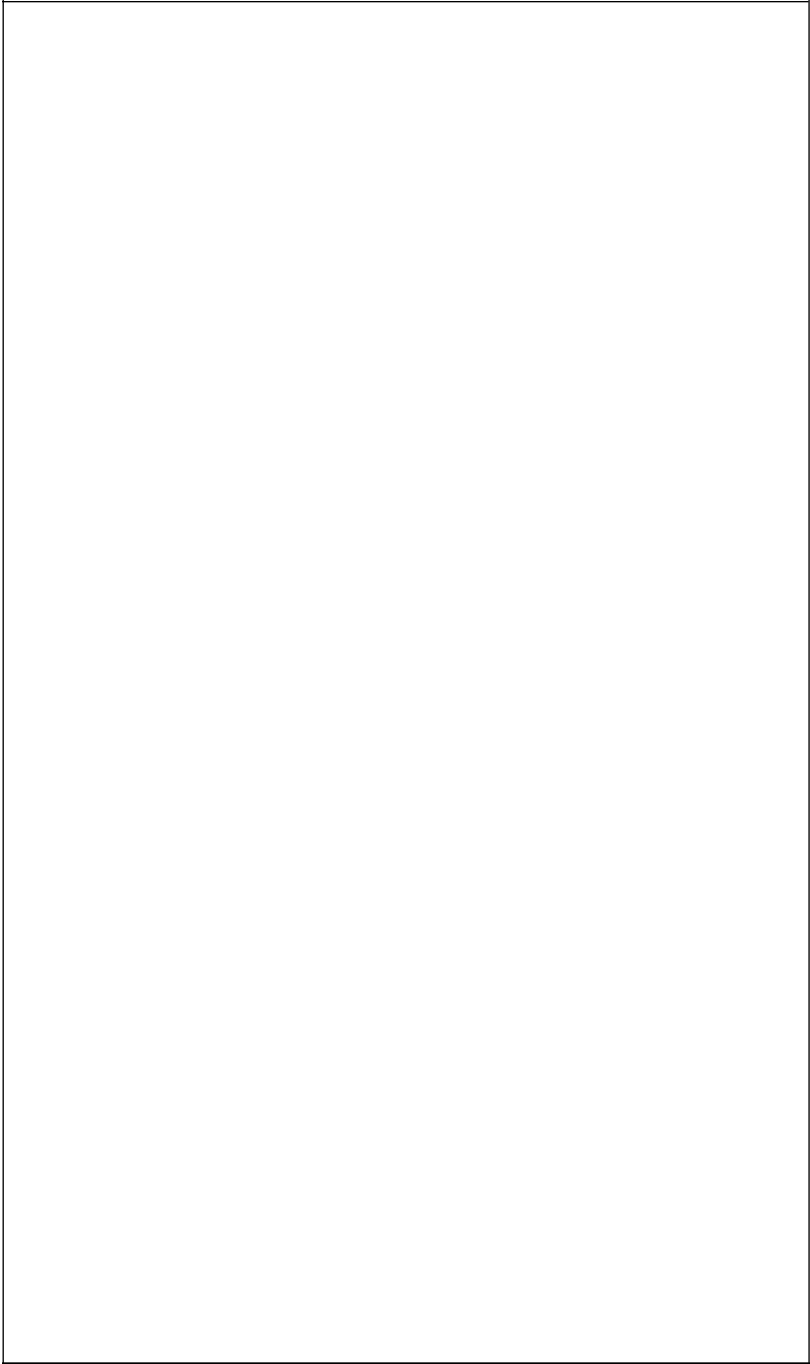
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Torquing Requirements

1993 National Electrical Code Section 110-3(b)

Published: October 1987

Underwriters Laboratories (UL) requires all terminals and lugs to pass more stringent tests as a part of the listing process. As a result, the listings for terminals and lugs now include specific torquing requirements. All manufacturers are required to identify appropriate torque values for each type of termination as part of their installation instructions. It is the contractor's responsibility to ensure that all terminations are properly torqued. It is the inspector's responsibility to verify correct installations.

To this end, the local inspection jurisdictions have established the following inspection requirements:

1. When manufactured, breakaway torquing devices are used, terminations will be considered to be installed in accordance with the manufacturers instructions. The breakaway portions of these devices shall be left on the job site until the installation has been inspected.
2. When other torquing methods are used, the inspection jurisdiction will normally require that torquing tools and manufacturers torquing instructions be on the job site at the time of inspection.
3. As an alternate to 1 or 2 above, the inspection jurisdiction may accept a letter from the contractor certifying that all terminations have been torqued in accordance with the manufacturers instructions.
4. At any time where it is apparent that terminations have not been properly torqued, the inspection jurisdiction may require that the contractor employ a third party, acceptable to the jurisdiction, to witness and certify the proper torquing of all terminations.

Electrical Equipment Rooms

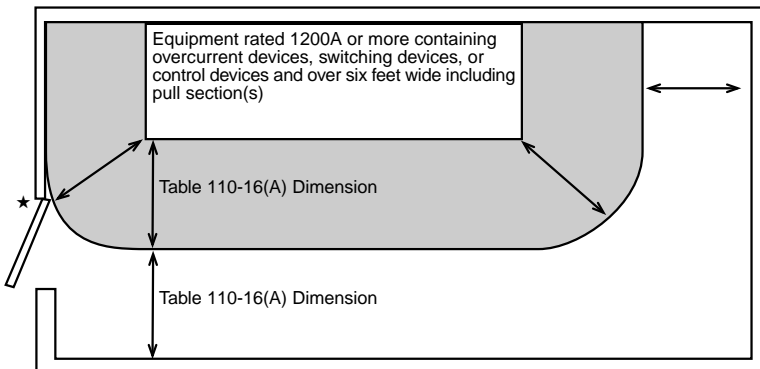
1993 National Electrical Code Section 110-16(c)

Published: October 1987. Revised: June 1991.

Section 110-16(c) now uses the term "equipment" instead of "switchboards and panelboards". The intent is to include any type of equipment that contains overcurrent, switching or control devices. The local inspection jurisdictions have made the following interpretations regarding this section:

1. This section applies only to equipment individually listed and marked with a 1200A or larger rating.
2. Pullsections rated 1200A or larger will be considered to be "equipment."
3. The widths of all individual sections of 1200A or larger rated equipment installed in the same room or area will be included in the six foot measurement to determine if two doors are required.
4. The clearance required in Table 110-16(a) Exception No. 2 to the nearest edge of the door is a radial measurement from the equipment. (See drawing)
5. Electrical equipment room doors shall open out and shall utilize "lever-operated" hardware. Lever-operated hardware is a type that permits the door to be opened from inside the room without the use of hands.

Note: The utility company requires that these doors be at least 30" wide.



★ Edge of the door closest to the equipment must be outside of Table 110-16(A) Dimension

Enclosed Patio

1993 National Electrical Code Section 210-52(a)

Published: April 1985.

Patios and sun decks, even when enclosed with screen or plastic windows, are not considered to be habitable rooms.

Because of this, receptacles are not required. However, any receptacle voluntarily installed will require GFCI protection.

Additionally, when such receptacles are exposed to the weather, weatherproof covers will be required.

Feeder Diagrams (Electrical Plans)

1993 National Electrical Code Section 215-5

Published: April 1985. Revised: June 1991.

The intent of this newsletter is to clarify the general requirements for electrical plans for installations in the San Diego area.

For residential services of 200 amperes or less, a plan showing the size, location and AIC rating of the service equipment is required. A circuit card or "as-built" plan is required.

All commercial services regardless of size, and residential services over 200 amperes require complete electrical plans. These plans shall include a description of all loads to be served, the size of service, feeder and branch circuit overcurrent devices, the size and type of conductors, the AIC rating of equipment, grounding and bonding details and the wiring methods to be utilized. Calculations to justify the proposed installation must be provided. Generally, single-line diagrams will be required as well as plans showing the location of all proposed electrical equipment to be installed.

In addition, plans and calculations must be provided for lighting loads regulated by the Energy Conservation Regulations of Title 24.

All Electrical Plans shall be signed as required by the California State Business and Professions Code and, where applicable, shall contain the Statement of Compliance required by Title 24.

The San Diego Chapter of ICBO also recommends that each jurisdiction require meter locations be shown on all building plans (except one and two family dwellings) prior to permit issuance, and that each jurisdiction verify these locations in the field prior to its final approval of the gas and electric systems. Plan review should include review of code provisions, such as exit court requirements and requirements for fire protection of exterior walls based on distance to property line.

Note: These general plan requirements are based on typical installations. An inspection jurisdiction may find it necessary to require additional plans or calculations at any stage of design or construction.

Number of Services

1993 National Electrical Code Section 230-2

Published: December 1981. Revised: January 1996

Some of the multiple services permitted as exceptions to Section 230-2 conflict with other provisions of Article 230, with the policies of the utility company, and with established wiring methods in the San Diego area. Such services can present a hazard in certain normal and emergency situations.

The intent of this newsletter is to establish conditions regarding the installation of multiple services that resolve such conflicts and provide for safety in both normal and emergency situations.

Section 230-2 is reprinted below with local conditions regarding its application shown as notes in capital letters. Installations of multiple services in the San Diego area must conform to these conditions to be acceptable to the inspection jurisdictions and the utility company.

230-2. Number of services. A building or other structure served shall be supplied by only one service.

Where more than one service is permitted by any of the following exceptions, a permanent plaque or directory shall be installed at each service drop or lateral or at each service-equipment location denoting all other services on or in that building or structure and the area served by each.

NOTE: THE PLAQUE REQUIRED BY THIS SECTION SHALL BE METAL OR PLASTIC, WITH ENGRAVED OR MACHINE PRINTED LETTERS IN A CONTRASTING COLOR TO THE PLAQUE, SHALL INCLUDE A PLAT MAP OF THE ENTIRE BUILDING, AND SHALL BE ATTACHED TO THE SERVICE DISCONNECT WITH SCREWS, POP-RIVETS, OR EPOXY. FOR MINIMUM LETTER SIZE AND ACCEPTABLE WORDING, SEE SAMPLE PLAQUES ON PAGES 4 & 5 OF THIS NEWSLETTER.

DOORS INTO ELECTRICAL METER ROOMS MUST BE CLEARLY AND LEGIBLY MARKED "ELECTRIC METER ROOM". IF THERE ARE MULTIPLE ELECTRIC METER ROOMS, THE DOORS MUST BE MARKED "ELECTRIC METER ROOM #___ of ___", AS APPROPRIATE.

REFERENCE: 1994 UNIFORM FIRE CODE, SECTION 8509.3

Exception 1: For fire pumps where a separate service is required.

cont.

Number of Services *Continued* (Page 2 of 5)

Exception 2: For emergency, legally required standby, optional standby, or parallel power production systems where a separate service is required.

Exception 3: Multiple-Occupancy Buildings. By special permission, in multiple-occupancy buildings where there is no available space for service equipment accessible to all the occupants.

NOTE: PERMISSION WILL NOT NORMALLY BE GRANTED UNLESS THE BUILDING IN QUESTION QUALIFIES FOR A SEPARATE SERVICE UNDER EXCEPTION 5.

Exception 4: Capacity Requirements. Two or more services shall be permitted:

- a. Where the capacity requirements are in excess of 2000 amperes at a supply voltage of 600 volts or less; *or*
- b. Where the load requirements of a single-phase installation are greater than the serving agency normally supplies through one service; *or*
- c. By special permission.

NOTE: THE DISCONNECTS FOR SUCH SEPARATE SERVICES SHALL BE GROUPED.

Exception 5: Buildings of Large Area. By special permission, for a single building or other structure sufficiently large to make two or more services necessary.

NOTE: FOR NEW BUILDINGS, SPECIAL PERMISSION WILL BE CONSIDERED WHEN ALL OF THE FOLLOWING CONDITIONS CAN BE MET.

1. THE UTILITY COMPANY AGREES TO PROVIDE AN ADDITIONAL SERVICE.
2. THE BUILDING IS OF SUCH SIZE THAT THE SEPARATE SERVICES WILL BE A MINIMUM OF 150 FEET APART, IN A STRAIGHT LINE.
3. THE BUILDING IS VERTICALLY DIVIDED INTO SEPARATE AREAS AND, EXCEPT FOR A COMMON HOUSE

cont.

Number of Services *Continued* (Page 3 of 5)

SERVICE, EACH AREA IS SERVED BY ONLY ONE SERVICE.

FOR EXISTING BUILDINGS, SPECIAL PERMISSION WILL BE CONSIDERED ON A CASE BY CASE BASIS. GENERALLY CONDITIONS 1 AND 2 ABOVE WILL BE REQUIRED AS WELL AS A PLAQUE ON EACH SUB-PANEL TO IDENTIFY WHICH SERVICE SUPPLIES THE PANEL.

Exception 6: For different characteristics, such as for different voltages, frequencies, or phases, or for different uses, such as for different rate schedules.

NOTE: THE DISCONNECTS FOR SUCH SEPARATE SERVICES SHALL BE GROUPED.

Exception 7: For the purpose of Section 230-40, Exception No. 2 only, underground sets of conductors, size 1/0 and larger, running to the same location and connected together at their supply end but not connected together at their load end shall be considered to be one service lateral.

NOTE: THIS INSTALLATION VIOLATES THE POLICIES OF THE UTILITY COMPANY AND WILL NOT BE PERMITTED.

NOTE: OTHER INSTALLATIONS OF MULTIPLE SERVICES WILL REQUIRE THE APPROVAL OF BOTH THE UTILITY COMPANY AND THE INSPECTION JURISDICTION.

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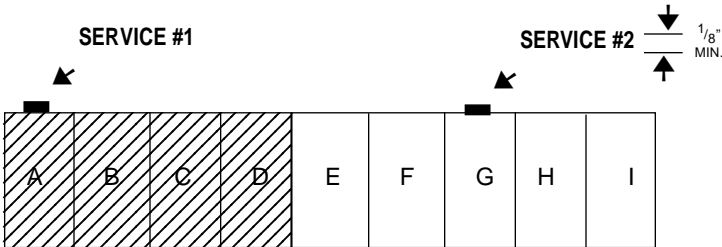
TYPICAL PLAQUE FOR NEW BUILDINGS OR EXISTING
BUILDINGS WITH SEPARATE SERVICE AREAS

SERVICE 1 of 2 $\frac{3}{4}"$
MIN.

There is (1) other service on this buiding as shown below.

The shaded area indicates the area controlled by $\frac{1}{4}"$
this service at the time of installation.

Confirm the Actual Service Connections before beginning
any electrical work in this building.



The plaque or directory required by Section 230-2 shall be
metal or plastic, with engraved or machine printed letters,
or electro-photo plating, in a contrasting color to the plaque,
shall include a plate map of the entire bulding, and shall
be attached to the service disconnect with pop-rivots,
screws, or epoxy.

cont.

TYPICAL PLAQUE FOR EXISTING BUILDINGS WITH
INTERMIXED SERVICES

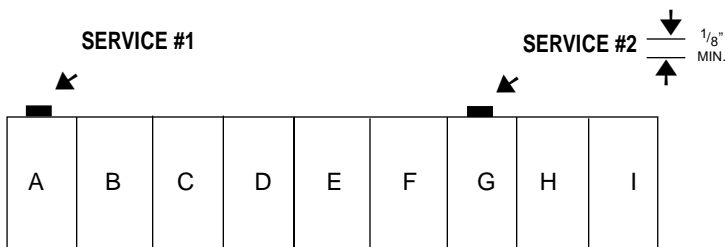
SERVICE 1 of 2 $\frac{3}{4}"$ MIN.

There is (1) other service on this building as shown below.

Each of these services supply loads throughout $\frac{1}{4}"$ MIN.
the building.

Confirm the actual service connections before beginning
any electrical work in this building.

Plaques are required on each distribution panel to
identify which service supplies that panel.



The plaque or directory required by Section 230-2 shall be
metal or plastic, with engraved or machine printed letters,
or electro-photo plating, in a contrasting color to the plaque,
shall include a plate map of the entire building, and shall
be attached to the service disconnect with pop-rivets,
screws, or epoxy.

Number of Service-Entrance Conductor Sets

1993 National Electrical Code Section 230-40

Published: April 1985. Revised: January 1996

Exception 1: Buildings with more than one occupancy shall be permitted to have one set of service-entrance conductors run to each occupancy or to a group of occupancies.

THIS EXCEPTION PROVIDES FOR AN INSTALLATION THAT VIOLATES THE POLICIES OF THE INSPECTION JURISDICTIONS AS WELL AS THE SAFETY REQUIREMENTS OF THE FIRE SUPPRESSION SERVICES. INSTALLATIONS OF THIS TYPE ARE NOT ACCEPTABLE IN THE SAN DIEGO AREA.

Underground Service Conduits

1993 National Electrical Code Section 230-43

Published: July 1980. Revised: June 1991

Underground service conduits installed in, on or under any building structure or service panel shall be a type identified in Art. 230-43 and listed for the purpose. The installation of this conduit shall be inspected by the local inspection jurisdiction and the utility company.

Underground service conduits that are privately owned and will be privately maintained must meet these same requirements.

Other underground service conduits may be of a type acceptable to the utility company and the installation of these conduits shall be inspected by the utility company.

The number and size of underground service conduits shall be determined by the utility company.

Ground Fault Performance Testing

1993 National Electrical Code Section 230-95
Published: April 1989. Revised: January 1996

Section 230-95 requires that certain services be provided with a ground fault protection system. Subsection (c) requires that tests be performed on such systems, presumably to assure that the equipment performs its intended function. This code section does not define who is to perform these tests or what information is to be included in the written report for inspection jurisdictions. Additionally, the requirement that these tests be performed on the system "when first installed on site" allows tests to be made at inappropriate times.

A ground fault protective system includes the Ground Fault Device (main disconnect and fault current sensor) and all wiring supplied by this device. For this reason, performance testing should normally be accomplished after all wiring is installed to insure that the ground fault device functions properly.

The following standards are established to assure that performance testing of ground fault systems is accomplished in a uniform and acceptable manner:

1. Performance testing shall be performed by a third party capable of demonstrating both the knowledge and equipment necessary for such tests.
2. The Ground Fault Protective System must be tested after all wiring is installed and before the building is approved for occupancy.

Exception: Where a temporary service is allowed for construction or equipment testing, prior to the final approval of the building, it is permissible for the testing of the ground fault protective system to be accomplished in two separate parts.

Part 1. Testing of the ground fault protective device must be completed before the service will be energized. This provides a reasonable level of protection for the service equipment during the period that temporary wiring is in use.

Part 2. The neutral and ground connections may then be tested after all wiring is installed and before the building is approved for occupancy. Generally, this testing requires that the service be de-energized. If the service is energized, coordination with the utility company will be necessary to deenergize for testing.

cont.

Ground Fault Performance Testing (Page 2 of 2)

3. The written record of the test shall include:
 - a) A copy of the manufacturer's instructions for performance testing of the equipment.
 - b) A statement that the service grounding connections are correctly installed for a ground fault system.
 - c) A statement that all neutral conductors in the distribution system have been tested and found to be ungrounded. Describe the test method used.
 - d) A statement that the ground fault equipment functioned properly when tested. Include the actual settings and trip-times of the tests.
4. Jurisdictions will not release temporary service or "Service Equipment Only" (S.E.O.) temporary services clearances to the utility when the testing required in Part 1 above has not been completed. If jurisdictions release S.E.O. or temporary service clearances when only Part 1 testing is complete, the release must specifically note that "Part 2 Ground-Fault tests are incomplete".

The use of permanent service equipment for temporary power is common in the industry. The standards established by this newsletter are intended to recognize and permit this use. It should be noted that most ground fault testing requires that the service be de-energized and that there are utility company fees for the disconnection and reconnection of power.

Bonding of Sprinkler Systems

1993 National Electrical Code Section 250-80(b)

Published: April 1985. Revised: June 1991

Interior metal sprinkler systems are considered to be "other metal piping" and shall be bonded. The bonding jumper shall be sized in accordance with Table 250-95 using the rating of the circuit which may energize the piping.

Grounding Electrode System

1993 National Electrical Code Section 250-H

Published: December 1981. Revised: October 1987

This section has generated many questions regarding the use of metal underground water pipes as grounding electrodes, the type of grounding electrodes acceptable as supplements to a metal underground piping system, and the type of grounding electrode required where there is no underground water piping on the premises.

The intent of this newsletter is to interpret Sections 250-81 and 250-83 so that the requirements for grounding electrode systems are related to typical construction methods in a practical and consistent manner.

Section 250-81 requires that all grounding electrodes "available on the premises" be bonded together to form a grounding electrode system. In typical construction, such grounding electrodes are not usually available on the premises. The real problem is to insure that at least one permanent and effective grounding electrode is installed on every premises.

The following requirements for the installation of grounding electrodes meet the intent of Section 250-81 and are consistent with typical construction methods. These requirements are mandatory in the San Diego area.

1. Any construction that includes new concrete foundations shall be provided with a concrete-encased electrode of the type identified in Section 250-81(c).

Exception #1. A concrete-encased electrode need not be made available where the grounded metal frame of the structure is used as the grounding electrode. See Section 250-81(b).

Exception #2. A concrete-encased electrode need not be made available where a ground ring is installed as the grounding electrode. See Section 250-81(d).

Note: Where a concrete encased electrode of the type identified in Section 250-81(c) was properly installed but is not available at final, a grounding electrode consisting of 20 feet of #2 Bare Copper Conductor buried at a depth of 2-1/2 (30") feet in a trench parallel to and at least 18" away from the foundation of building may be substituted. The conductor forming the grounding electrode must be continued, unbroken and unspliced, to the service. Ground Rods are not acceptable substitutes for the required grounding electrodes for new construction.

2. Other construction shall be provided with at least one of the grounding electrodes specified in Sections 250-81 or 250-83. Existing underground metal water piping systems shall be supplemented by an additional electrode when new services are installed on existing

cont.

Grounding Electrode System (Page 2 of 2)

buildings.

Note: Utility Company sealing and access requirements prohibit the installation of grounding electrodes or grounding electrode conductors in the utility area of pull sections or pull cans.

Concrete Encased Electrode (Rebar)

1993 National Electrical Code Section 250-81

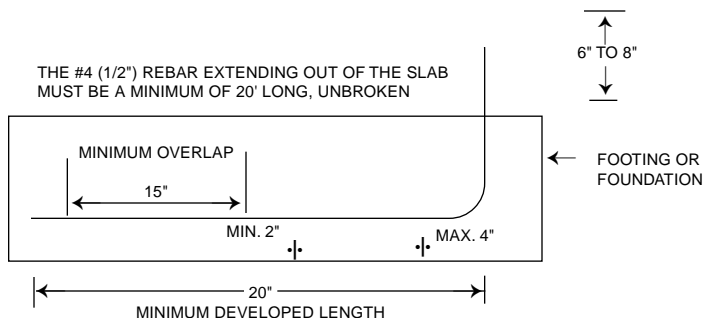
Published: May 1980. Revised: April 1985

The NEC makes it clear that underground metal water pipe can no longer be relied on to assure a permanent and effective ground. To this end, several different grounding electrodes are identified as acceptable alternatives to the water pipe. The two most commonly used are the ground rod and the concrete encased electrode. While the use of ground rods is fairly straightforward, the use of concrete encased electrodes has raised many questions.

The intent of this newsletter is to identify the minimum requirements for an acceptable concrete encased electrode constructed of reinforcing steel (rebar), commonly called a ufer ground. These minimum requirements are as follows:

1. The #4 ($\frac{1}{2}$ ") or larger rebar to which the grounding electrode conductor is connected must be a minimum of 20 feet long, unbroken.
2. The total developed length of rebar at the bottom of the foundation must be no less than 20 feet. Where splices are necessary to obtain the required 20 feet of rebar, they must be made so that the two bars overlap by no less than 15 inches and are secured by at least two steel tie wires.
3. The rebar may only extend out of the slab in a dry location.
4. The rebar must extend out of the slab at least six inches and no more than 18 inches and the point of connection of the grounding electrode connector must be accessible.

Exception: Where the connection of the grounding electrode conductor is encased in concrete.



Ground Rods

1993 National Electrical Code Section 250-83 (c)

Published: April 1985

Ground Rod installations have been a continuing source of problems. The following interpretations are intended to alleviate the more common problems and establish guidelines for a ground rod installation that will be generally accepted in the San Diego area:

1. It is more important that the connection to a ground rod be visible for inspection or reinspection than it is that it be buried to avoid possible physical damage. Therefore, it is acceptable to install a ground rod so that no more than 3" projects above ground level. Connection of the grounding electrode conductor shall be made on this accessible portion of the rod. Ground rods should be installed in areas where they are not subject to physical damage or provided with protection from such damage.
2. Although a #6 copper conductor is the largest electrode conductor required for a ground rod, it still requires protection from physical damage. The prohibition of metal conduits underground further complicates this requirement. It is noted that a #4 copper conductor only requires protection where exposed to severe physical damage. Jurisdictions will generally accept a #4 copper conductor run on an exterior surface, buried at a depth of 6", or, for short distances, run on the surface of the ground without additional protection. The use of a #4 copper grounding electrode conductor can greatly simplify the typical installation.
3. A connector is always required where the grounding electrode conductor enters the service equipment.
4. Only ground clamps listed for use with ground rods are acceptable.

Temperature Limitation of Conductors

1993 National Electrical Code Section 310-10

Published: December 1981

This section requires that the maximum ampacity of conductors, as permitted in Tables 310-16 through 310-19, be reduced whenever any combination of factors cause the temperature limit of a conductor to be exceeded.

The factors involved in heat generation in a conductor are:

- 1) Ambient temperature
- 2) Current flow
- 3) Rate of heat dissipation.
- 4) Adjacent current-carrying conductors

It is the opinion of the electrical members of the San Diego Chapter of ICBO that the ambient temperature of the San Diego Area does not exceed that permitted in Tables 310-16 through 310-19 to such a degree or for such a period of time that it requires a de-rating of conductor ampacity. One exception to this finding is the desert area of San Diego County. Check with the County of San Diego for specific de-rating required for installations in this area.

Installations of wiring in areas where the ambient temperature is abnormally high, such as boiler rooms, will require de-rating of conductors. Each case will be evaluated based on the conditions of the specific installations.

Installations of more than three current-carrying conductors in a raceway or cable shall be subject to the provisions of Note 8 to the ampacity tables.

Underground Conduit

1993 National Electrical Code Section 345-346-348

Published: April 1985

It is the finding of the inspection jurisdictions in the San Diego area that the soil conditions are not suitable for the direct burial of metallic conduits. Experience has shown that direct buried metallic conduits corrode rapidly, sometimes failing in as little as six months.

Therefore, the direct burial of metallic conduit is prohibited in the San Diego area.

Exception: Rigid Metal Conduit encased in concrete may be installed underground.

Exception: Rigid Metal Conduit with an approved non-metallic coating may be installed underground.

Switchboards

1993 National Electrical Code Section 384

Published: June 1990

The testing and listing standards for switchboards require that the manufacturer identify any equipment intended to be installed in the field. Equipment intended for field installation must be identified by part or catalog number on a label in the switchboard. The manufacturer must also provide any instructions necessary for the proper installation of such equipment. These requirements specifically include terminal connectors.

Most switchboards are designed to be connected to other sections or equipment with splice and through bus. Some switchboards also provide a set of factory installed terminals for tapping a single circuit ahead of the service main. Very few switchboards are designed for the field installation of terminals on busses in order to make cable connections. Those designed for this application will include the required markings and installation instructions.

The following procedures are established to insure that switchboards are installed in conformance with the testing and listing standard for such equipment.

1. Plan reviewers will reject plans showing field connection of cable to busses unless there is documentation that the equipment is suitable for the field installation of terminals.
2. All new switchboards will be inspected to determine compliance with the listing and manufacturer's instructions provided with the equipment.
3. All installations of new cables in existing switchboards will be inspected to determine compliance with the listing and manufacturer's instructions provided with the equipment. In some cases, this will require changes to existing cable connections.
4. Switchboards not designed and marked for the field installation of terminals cannot be modified in the field, except by the manufacturer with a field evaluation and relisting by the original testing agency.

Transformer Ventilation

1993 National Electrical Code Section 450-9

Published: December 1981. Revised: January 1996

Transformers in enclosed spaces shall have provisions to maintain an ambient temperature which does not exceed the ambient temperature rating of the transformer and that does not require the derating of conductors in that area (Temperatures higher than 86 degrees F or 30 degrees C - See Ampacity Correction Factors in Table 310-16). This may be accomplished by natural or mechanical ventilation, by mechanical cooling, or by other means.

1. Natural ventilation which complies with the provisions of Section 450-45 shall be acceptable.
2. Mechanical ventilation which provides for air movement of 3 cubic feet per minute/per KVA of transformer rating shall be acceptable.
3. Mechanical cooling which can be demonstrated to maintain an ambient temperature below that of the transformer rating shall be acceptable.
4. Any other means, including combinations of the above methods, which can be demonstrated to maintain an ambient temperature below that of the transformer rating shall be acceptable.

Marinas

1993 National Electrical Code Section 555-1

Published: July 1980

Receptacles for shore power shall comply with Sections 555-3, -4, -5.

Receptacles for tools to be used on docks or boats shall comply with the following:

1. Receptacles shall be "U" ground type.
2. Circuits shall be protected by a G.F.C.I.
3. Load shall be calculated at 3 amperes per duplex receptacle.
4. Feeder demand shall be calculated per Section 555-5.
5. Circuits shall be labeled "Not to be used for boat/shore power".

Electric Signs and Outline Lighting

1993 National Electrical Code Section 600

Published: June 1990

The intent of this newsletter is to identify the minimum requirements for the installation of exposed neon tubing for signs and outline lighting.

The general requirement for signs is that they be listed by a qualified electrical testing laboratory. This requirement and the other requirements of Article 600 of the NEC are the standards for the installation of signs.

However, signs and outline lighting constructed with exposed neon tubing and assembled in the field cannot be listed. It is the responsibility of the local inspection jurisdictions to approve such installations. The following standards identify an approved installation method for such signs and outline lighting. Other installations may be acceptable if the installer can demonstrate the equivalent level of safety.

1. All parts of outline lighting or signs constructed with exposed neon tubing shall be installed no less than 8' above the floor where indoors and 8' above the finished grade where outdoors.
2. All secondary conductors must be enclosed in metal raceway which is effectively grounded or approved glass assemblies.
3. All tubing must terminate in listed receptacles, such as P.K.'s, or in approved glass assemblies and, where exposed to the weather, be sealed with listed weatherproof bushings.
4. A disconnect switch is required. It must be in sight of the outline lighting or sign. Where controlled by a timeclock, the disconnect switch must disconnect both the timeclock and the outline lighting or sign. If not within sight of the sign, the switch must be lockable in the open position.

Note: The NEC does not permit the installation of equipment with open circuit voltage exceeding 1000 volts in any residential occupancy.

Fire Pump Installations

1993 National Electrical Code Section 700

Published: June 1991

The standards for the installation of electrically driven fire pumps are contained in NFPA 20. This bulletin summarizes the general requirements for fire pump installations from NFPA 20 and the NEC. It is the responsibility of the Electrical Engineer to assure that the design of such installations complies with all applicable standards.

NORMAL POWER REQUIREMENTS

1. The normal power supply to a fire pump must be connected ahead of the building disconnecting means. On services over 600V, fire pumps may be connected ahead of the secondary mains. On other services, connection within the service equipment ahead of the main, on taps provided by the manufacturer, is acceptable.
2. The feeder to the fire pump must be metered and provided with a disconnect which is suitable for use as service equipment.
3. The disconnect must be in an enclosure separate from other building disconnects, be identified "Fire Pump Disconnect" in 1/2 inch or larger block letters, and be red or have the required identification on a red plaque.
4. Overcurrent protection for the fire pump feeder must be sized to carry the locked rotor currents of the fire pump motor(s), jockey pump and associated fire pump accessory equipment. Alternate overcurrent protection sizing may be acceptable if designed by an electrical engineer to provide equivalent protection.
5. Fire pump feeder conductors must have an ampacity equal to 125% of the total fire pump motor and equipment load.
6. Voltage drop may not exceed 5% at the motor under normal running conditions.
7. Voltage drop may not exceed 15% at the fire pump controller under starting conditions.
8. The fire pump controller must be listed for the purpose and must be installed outside or in a room which provides protection from fire or damage.
9. Fire pump service, feeder and circuit wiring must be outside of the building or, where inside, be under the slab or encased in concrete. It may be exposed only in an electrical equipment room, in the fire

cont.

Fire Pump Installations (Page 2 of 2)

pump room, in the generator room, or outside of the building. When so exposed, rigid metal conduit, intermediate metal conduit or liquidtight flexible metal conduit is required. Where buried outside of the building or under the slab, rigid nonmetallic conduit or rigid metal conduit either PVC coated or encased in concrete must be used.

GENERATOR POWER REQUIREMENTS

1. An on-site generator is required to provide emergency power for the fire pump. The generator shall be outside of the building or in a room designed to provide equivalent protection from fire or damage. The room shall be identified "Emergency Generator Room" in 1/2 inch block letters on a red plaque.
2. A separate main is required at the generator for the fire pump feeder.
3. Both the main and the feeder conductors from the generator to the fire pump controller must be sized to carry 125% of the total fire pump motor and equipment load.
4. Voltage drop may not exceed 5% at the motor under normal running conditions.
5. Voltage drop may not exceed 15% at the fire pump controller under starting conditions.
6. The transfer of power must take place in the fire pump room. No other transfer switches are permitted in the generator feed to the fire pump.
7. Fire pump service, feeder and circuit wiring must be outside of the building or, where inside, be under the slab or encased in concrete. It may be exposed only in an electrical equipment room, in the fire pump room, in the generator room, or outside of the building. When so exposed, rigid metal conduit, intermediate metal conduit or liquidtight flexible metal conduit is required. Where buried outside of the building or under the slab, rigid nonmetallic conduit or rigid metal conduit either PVC coated or encased in concrete must be used.

Exit Signs and Illumination

1993 National Electrical Code Section 700-12
Published: June 1991. Revised: January 1996

The intent of this Newsletter is to interpret the requirements of the 1994 Uniform Building Code (UBC) regarding exit signs and exit illumination for buildings, other than high rises, and to coordinate these requirements with those of the National Electrical Code (NEC).

EXIT SIGNS

The general requirements for exit signs are contained in Section 1013 of the UBC. Exit signs are required in all occupancies where two or more exits are required by Section 1003. Exits signs must indicate the direction of egress and identify the required exit doorways. All required exit signs must have an emergency source of power, unless they are of the approved self-luminous type. Any of the emergency sources identified for exit illumination are acceptable.

EXIT ILLUMINATION

The general requirements for exit illumination are contained in Section 1012 of the UBC. All occupancies are required to have exit illumination to light the path of egress. Power for exit illumination is provided by the premises electrical service. In occupancies where the exiting system serves an occupant load of 100 or more and in all Group I, Division 1.1 and 1.2 occupancies, an emergency source of power must also be provided to maintain the exit illumination in case of failure of the normal power. The UBC specifically requires that the emergency source of power be either storage batteries or an on-site generator.

OCCUPANT LOAD

The requirements for emergency power are applied on the basis of occupant load in the following manner:

1. The occupant load of the building exiting system (corridors, lobbies and stairways) is based on the total occupant load of the building. If any portion of the building exiting system serves an occupant load of 100 or more, emergency power is required for the exit illumination in all corridors, lobbies and stairways which are a part of the exiting system.
2. The requirement for emergency power for exit illumination in tenant spaces within a building is based on the occupant load of the space. Tenant spaces with an occupant load of 100 or more require emergency power for exit illumination in the tenant space.

cont.

Exit Signs and Illumination (Page 2 of 3)

3. Emergency power is required for all exit signs except the approved self-luminous type.

NEC REQUIREMENTS

The NEC requirements for the installation of emergency systems are found in Article 700. Section 700-12 requires that emergency systems provide power within 10 seconds of the failure of the normal power source and identifies the installation requirements for storage batteries and generators. Section 700-9 requires that emergency wiring be kept separate from all other building wiring and marked to identify it as a component of an emergency system.

ACCEPTABLE INSTALLATIONS

The coordinated application of UBC and NEC requirements permits the following installations to provide emergency power for exit signs and illumination:

1. An on-site generator that will start and provide power to all exit signs and exit illumination within 10 seconds and that has a two hour fuel supply on site. The emergency wiring must be separate from all other building wiring. All enclosures containing emergency wiring, including the transfer switch, the distribution panel or panels and all switch, receptacle and junction boxes must be marked red or labeled in red to clearly indicate that they are part of a separate emergency wiring system.
2. A storage battery or uninterruptable power supply (UPS) system that will provide power to all exit signs and illumination within 10 seconds and maintain an effective voltage level for a minimum of 1 1/2 hours. The requirement for a separate and identified emergency wiring system is the same as for on-site generators.
3. Unit fixtures as defined in Section 700-12(f) of the NEC. Such fixtures must provide effective illumination for a minimum of 1 1/2 hours, be listed for use as emergency lighting and be installed in accordance with NEC Section 700-12(f).

PLAN REQUIREMENTS

Plans submitted must identify the required exit paths and the building and tenant space occupant loads. Location of exit signs must be shown. The type, number and location of fixtures for exit illumination and the type of emergency systems, where required, must be shown.

LOW LEVEL EXIT SIGNS

In addition to the general requirements, Low Level Exit Signs are required at exits in all rated corridors of Group R, Division 1 Occupancies, Group A Occupancies, and Group E Occupancies. Low Level Exit Signs

cont.

Exit Signs and Illumination (Page 3 of 3)

must be listed as Exit Signs in compliance with U.L. Standard 924.

LOW LEVEL EXIT PATH MARKING

Low Level Exit Path Marking is required in the interior corridors of unsprinklered Group R, Division 1 Occupancies, and unsprinklered Group A Occupancies. Low Level Exit Path Marking Systems must be listed in compliance with U.L. Standard 1994.

Fire Alarm Systems

1993 National Electrical Code Section 760

Published: October 1987. Revised: January 1996

The intent of this newsletter is to identify the general requirements for fire alarm systems.

Fire alarm systems, including design, installation, and inspection are regulated by the State Fire Marshall and, by delegation, by the local Fire District. Fire alarm systems are covered in Section 1007 of the Uniform Fire Code.

Articles 700 and 760 in the NEC regulate fire alarm power supply and installation of alarm wiring, respectively.

REQUIRED POWER SUPPLY

1. A light and power service employed to operate the system under normal conditions shall have a high degree of reliability and capacity for the intended service. This service shall consist of one of the following:
 - (a) Two-wire Supplies: A two-wire supply circuit may be used for either the primary (main) operating power supply or the trouble signal power supply of the signaling system.
 - (b) Three-wire Supplies: A three-wire ac or dc supply circuit having a continuous unfused neutral conductor or a polyphase ac supply circuit, having a continuous unfused neutral conductor where interruption of one phase does not prevent operation by the other phase, may be used with one side or phase for the primary (main) operating power supply and the other side or phase for the trouble signal power supply of the signaling system.

Connections to the light and power service shall be on a dedicated branch circuit. The circuit and connections shall be mechanically protected. The circuit disconnecting means shall be accessible only to authorized personnel, have a lock-on device, and shall be clearly marked "FIRE ALARM CIRCUIT CONTROL".

REFERENCE: SECTION 1.5, NFPA 72 - 1993

NOTE: THE LOCAL INSPECTION JURISDICTIONS AGREE THAT S. D. G. & E. DISTRIBUTION AND SERVICE SYSTEMS PROVIDE THE DEGREE OF RELIABILITY REQUIRED FOR FIRE ALARM POWER SUPPLIES.

cont.

IT IS FURTHER AGREED THAT FIRE ALARM BRANCH CIRCUIT DISCONNECTING MEANS SHALL BE CONSIDERED TO BE "ACCESSIBLE ONLY TO AUTHORIZED PERSONNEL" WHEN THE DISTRIBUTION PANEL CONTAINING THE DISCONNECTING MEANS:

1. IS IN A LOCKED ELECTRICAL EQUIPMENT ROOM, OR
2. HAS A LOCKABLE COVER OR DOOR, OR
3. IS LOCATED IN AN AREA WHERE ACCESS IS RESTRICTED TO AUTHORIZED PERSONNEL.

IN ADDITION TO THE REQUIRED MARKING, ALL FIRE ALARM BRANCH CIRCUIT DISCONNECTING MEANS SHALL BE PROVIDED WITH A LOCK-ON DEVICE TO PROTECT AGAINST ACCIDENTAL DISCONNECTION.

ADDITIONAL REQUIREMENTS

1. San Diego Gas and Electric Company requires all fire alarm systems to be metered.
2. All fire alarm systems must be approved and listed by the State Fire Marshall.
3. Certain occupancies may require visual alarms for the hearing impaired.

Grounding of Communication and CATV Systems

1993 National Electrical Code Section 800/820

Published: November 1990

Articles 800 and 820 of the National Electrical Code establish the standards for communication and cable T.V. systems. The local inspection jurisdictions do not issue permits for these installations and, therefore, do not normally perform inspections of such systems. It is the responsibility of the owners and installers of such systems to assure that these installations comply with the requirements of the NEC. The most important of these requirements relates to the grounding of the metallic sheath of such cables. Grounding is required to provide protection against lightning and high voltage conditions. The grounding requirements of Article 800, Communications Circuits and Article 820, Community Antenna Television and Radio Distribution Systems are summarized below. All installers should be aware of and comply with these code requirements.

- A. A separate grounding conductor shall be installed for each communications and CATV installation. Each grounding conductor shall not be smaller than No. 14.
- B. The grounding conductors shall be run to the grounding electrode in as straight a line as practical. The conductor must be unbroken and unspliced.
- C. The grounding conductor(s) shall be connected at the nearest accessible location to one of the following:
 - 1) Grounding Electrode System as covered in Section 250-81.
 - 2) The grounded interior metal water piping system as covered in Section 250-80(a).
 - 3) The power service accessible means external to enclosures as covered in Section 250-71(b).
 - 4) The metallic power service raceway.
 - 5) The service equipment enclosure.
 - 6) The grounding electrode conductor or the grounding electrode conductor metal enclosure.
 - 7) The grounding conductor or grounding electrode of a building or structuredisconnecting means which is grounded to an electrode as covered in Section 250-24.
 - 8) If the building or structure served has no grounding means as described above, the grounding conductor shall be connected to: (1) and effectively grounded metal structure, or (2) to any one of the individual electrodes described in Section 250-83.

cont.

Grounding of Communication and CATV Systems (Page 2 of 2)

- D. The grounding electrode connections shall comply with Section 250-115. All connections shall be accessible.
- E. Where separate grounding electrodes are used, they shall be bonded using a bonding jumper not smaller than No. 6 copper or equivalent conductor.

Smoke Detectors – Location in Dwelling Units

1993 National Electrical Code Section UBC 310.9.1

Published: July 1992. Revised: January 1996

This newsletter describes the 1994 UBC requirements for smoke detectors in dwelling units and provides interpretations as necessary for the acceptable installation of smoke detectors.

GENERAL REQUIREMENTS

All smoke detectors must be listed by a recognized testing agency, approved by the State Fire Marshall and installed in conformance with the manufacturer's instructions. Smoke detectors must be powered from the building wiring system with no switches in the circuit except the required overcurrent protection, be equipped with a battery backup, and have a "low battery" warning signal.

WIRING

All smoke detectors in a dwelling unit shall be wired so that the activation of any one detector will cause all other smoke detectors in the dwelling to alarm. Exception: Where the inspection jurisdiction determines that the audibility requirement of Section 310.9.1.5 will be met without such interconnection.

LOCATION

A smoke detector shall be installed in every sleeping room in a dwelling unit. In addition, at least one smoke detector shall be installed on every story of a dwelling unit, including the basement and each level of a split level.

Note: This requirement will apply to existing dwelling units under certain conditions. When a new sleeping room is added to a dwelling unit or when any addition, alteration, or repair is made which exceeds \$1,000 in valuation and requires a permit, smoke detectors must be installed in compliance with this Section. However, these smoke detectors need not be interconnected and may be solely battery powered. Repairs to the exterior of a dwelling unit are exempt from these requirements.

cont.

Smoke Detectors - Location in Dwelling Units (Page 2 of 2)

Smoke detectors shall be located on each story as described below:

SINGLE STORY DWELLING UNITS

A smoke detector shall be located on the wall or ceiling at a point centrally located in the corridor or area giving access to each separate sleeping area.

MULTI-STORY DWELLING UNITS

- On a story which provides grade level egress and contains no sleeping areas, the smoke detector(s) shall be located on the wall or ceiling within 5' of the stairway.
- On a story which provides grade level egress and contains sleeping areas, the smoke detector(s) shall be located in the same manner required for single story dwelling units.
- On each story above the grade level story, the smoke detector shall be located on the ceiling of the stairway landing. If there is more than one stairway, a smoke detector is required for each.

BASEMENTS

The smoke detector shall be centrally located in the basement on the ceiling. If there is an interior stairway into the dwelling unit, an additional smoke detector shall be located on the wall or ceiling at the top of the stairway.

Notes: The local inspection jurisdiction may require additional smoke detectors to assure that a particular installation satisfies the requirements of Section 310.9.1. Listed central alarm systems are acceptable where they are powered from the building wiring system and provide battery backup and interconnection of all detectors.